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ELECTRIC DISCHARGE TUBE WITH PLANAR ELECTRODES

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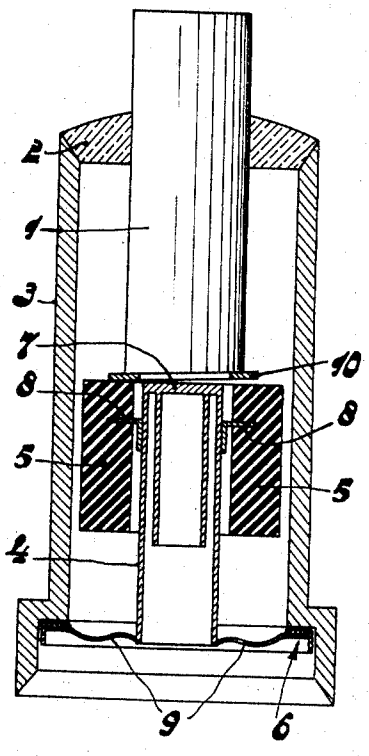


Fig. 1.

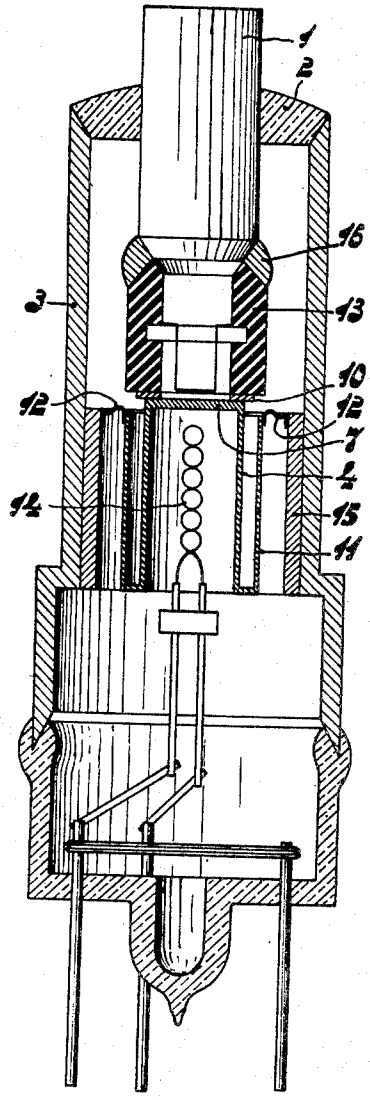


Fig. 2.

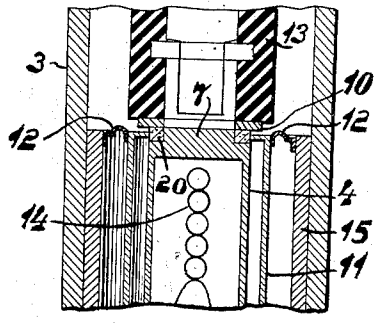


Fig. 3.

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ELECTRIC DISCHARGE TUBE WITH PLANAR ELECTRODES

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4 Claims. (Cl. 313—250)

The invention relates to electric discharge tubes of the kind comprising planar electrodes and, more particularly, to tubes for use with short waves, in which the electrodes are stacked up to form one system and in which the cathode is correctly spaced apart from the next following electrode by moving it at right angles to the cathode surface so that it resiliently bears on a spacer.

In such tubes many constructions have been used to ensure that very small distances between the cathode and the next following electrode may be realized in a reproduceable manner. For this purpose use has frequently been made of cathodes, of which the disc-shaped emissive surface is secured to the end of a cylinder, which is housed in an insulating body in a manner such that the emissive surface can be ground together with an end surface to the insulating body and thus forms a fitting surface. The spacing between the cathode and the next following electrode is then determined by clamping a foil of particular thickness between this fitting surface of the insulating body and a fitting surface of the next following electrode. The cathode is then mostly resiliently suspended in the tube at the other end of the supporting cylinder or the insulating body. Particularly for short-wave tubes it is then required that the suspension device, which frequently serves as a cathode current supply lead should have a large surface and be, furthermore, sufficiently resistant to lateral displacement of the cylinder. Consequently, it is required that the cathode should, as far as possible, be resiliently displaceable only in a direction at right angles to the emissive surface, for example as in the case of expansion due to heat.

In such constructions the difficulty is experienced that it is practically impossible to introduce the cathode into the tube in a manner such that the fitting surface of the cathode is exactly parallel to the fitting surface of the next following electrode. The fact is that the surfaces will first contact with one another on one side, so that when being pressed together the cathode body must slightly tilt over, since it slides sideways over the fitting surface only with difficulty. This tilting produces a lateral deviation of the other end of the cathode tube, which deviation is proportional to the length of the cathode. The resilient suspension device of the cathode provided at this end must then compensate for the lateral deviation. Since, however, this suspension device is only suitable to resiliently compensate for deviations at right angles to the cathode surface and has a great resistance for lateral motions, the lateral deviation will result in a deformation of the resilient parts. These parts are mostly made of thin strips or a thin diaphragm. This results in a deformation of these parts and hence an uneven spring effect. In many cases this deformation would become excessive, so that the tilting would be insufficient to cause the fitting surfaces to coincide completely.

According to the present invention, an electric discharge tube comprising a planar cathode, having a fitting surface and being correctly spaced apart from a next following electrode by means of a spacing member, the cathode being resiliently suspended and resiliently urged against said spacing member in a direction at right angles to the fitting surface of the cathode, is characterized in that the suspension device used for the resilient suspension of the cathode is located substantially in the same plane as the fitting surface of the cathode. Then the tilting of the cathode substantially does not produce lateral displacement of the cathode cylinder in the suspension plane.

In order that the invention may be more clearly understood and readily carried into effect, it will now be described with reference by way of example to the accompanying drawing, in which

Fig. 1 shows a known construction;

Fig. 2 shows a tube according to the invention; and

Fig. 3 is a modified construction of the invention.

Fig. 1 shows an ultra short-wave diode, of which the anode **1** has a fitting surface at the lower end, of which the deviation from the position at right angles to the centre line of the anode is shown on an exaggerated scale.

The anode **1** is sealed rigidly by means of a glass ring **2** in the metal cap **3**.

At its upper end the cathode tube **4** supports the emissive part **7** proper and is secured in the insulating ring **5** by means of strips **8**. When the cathode **4** has substantially taken up its place, the springs **9** provide the centering with respect to the tube wall **3**. The cathode surface **7** is ground to be flat together with the insulating body **5**, which is urged resiliently against the spacing foil **10**, secured to the fitting surface of the anode **1**. The foil thickness then determines the spacing between the cathode **4** and the operative anode surface.

In general, the fitting surfaces of the cathode and the anode will, however, not be completely parallel, as is shown in Fig. 1 on a greatly exaggerated scale. Consequently, if the insulating body **5** is urged against the foil **10** by the upward pressure of the springs **9** at the point **6** during mounting, the cathode will have to tilt to such an extent that the fitting surfaces extend parallel to one another. The lower end of the cathode cylinder **4** will have to move laterally, the amount of which movement is proportional to the length of the cylinder. However, at this end is generally provided the resilient suspension device or springs **9**, which serve at the same time as a current supply lead. This device **9** mostly comprises a number of thin walled strips, or, if desired, a corrugated diaphragm. Such a device is suitable to compensate for motions in the axis of length of the cathode, but lateral deviations produce uneven deformations of this suspension device and great reactive forces.

This difficulty is substantially completely avoided in a tube according to the invention, as shown in Fig. 2. Here reference numeral **1** again designates the anode, which is sealed by means of a glass ring **2** in a metal envelope **3**. The cathode **4** is, in this case, however, secured at the lower end to a thin walled, but strong cylindrical part **11**, whilst the resilient strips **12** are secured here to the upper end of the cylinder **11**, i. e. substantially flush with the fitting surfaces. The tilting of the cathode does not produce a lateral shift of the cathode in this plane. Prior to the introduction of the cathode into the tube, the resilient strips **12** are secured to a cylinder **15**, which is adapted, if required, to fit slideably within the tube wall, since in this case the cathode **4** is adapted to be freely adjusted. The lower end of the cathode body **4** is adapted to move laterally without causing difficulties with respect to the deformation of the resilient strips **12**. Since the divergencies from the parallel position of the fitting surfaces are invariably small, the lower end of the cathode cylinder **4** will not deviate to such an extent that difficulties are experienced when the heating body **14** is introduced.

In this construction the insulating body **13** is secured to the anode, since in this case the cathode is one of the kind in which the emission takes place by diffusion of active material to the surface, which is, consequently, metallic and does not bear an emissive oxide layer. Therefore the cathode surface itself can bear on the spacing foil **10**. In this case the active end of the anode **1** is ground, together with the insulating body **13**, to be flat. The insulating body **13** is secured to the anode **1** by means of enamel **16**.

Although the figures show diodes, the principle of the invention may, as an alternative, be applied to stacked

constructions of multi-electrode tubes, in which parallel fitting surfaces are pressed against one another, as a rule, with the use of a spacing body.

It is highly desirable that the fitting surfaces should coincide with one of the active electrode surfaces, since in this case it is ensured that the correct distance is determined by the thickness of the spacer. If use is made of a cathode having an emissive oxide layer, the oxides may be applied to a restricted part of the cathode surface, so that a metallic fitting edge is left. Alternatively, as shown in Fig. 3, an insulating body **20** may be secured to the cathode, having a fitting surface which coincides with the cathode surface. In this case, the body **20** engages the spacer **10**. The parts of Fig. 3 corresponding to those of Fig. 2 have the same reference numerals.

What I claim is:

1. An electric discharge tube comprising an envelope, a cathode having a planar surface disposed within said envelope and having an end remote from said planar surface freely moveable in said envelope, an electrode having a planar surface portion disposed within said envelope opposite to the planar surface of said cathode, a spacer member interposed between and abutting said planar surfaces, and means secured to said cathode at a point adjacent said planar surface of said cathode and resiliently supporting and urging said cathode against said spacer member, said resilient means being disposed substantially in the same plane as the planar surface of the cathode.

2. An electric discharge tube as claimed in claim 1 in which the planar surface of the cathode constitutes an electron emissive portion thereof.

3. An electric discharge tube comprising an envelope, a cathode having a planar electron emissive surface

disposed within said envelope and having an end remote from the planar surface freely movable therein, an electrode having a planar surface portion disposed within said envelope opposite to the planar surface of said cathode, an insulating member affixed to said electrode and having a planar surface in substantially the same plane as the planar surface portion of said electrode, a spacer member interposed between the planar surfaces of the cathode and the insulating member, and means resiliently supporting and urging said cathode against said spacer member, said resilient means being disposed substantially in the same plane as the planar surface of the cathode.

4. An electric discharge tube comprising an envelope, a cathode having a planar electron emissive surface disposed within said envelope and having an end remote from said planar surface freely moveable therein, an electrode having a planar surface portion disposed within said envelope opposite to the planar surface of said cathode, an insulating member affixed to the cathode and having a planar surface in the same plane as the planar surface of the cathode, a spacer member interposed between the planar surfaces of said insulating member and said electrode, and means resiliently supporting and urging said cathode and insulating member against said spacer member, said resilient means being disposed substantially in the same plane as the planar surface of the cathode.

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